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COMMENT ON THE "REPORT OF THE SPECIAL COMMITTEE ON THE LAKE SUPERIOR REGION"

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ALFRED C. LANE  
Lansing, Mich.

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In signing and assenting to the publication of the "Report of the Special Committee on the Lake Superior Region,"<sup>1</sup> it was agreed that the various members of the committee should have a right to add, or to publish elsewhere, notes explanatory of their subscription to the official creed. It may perhaps be worth the cost for me to explain why I was willing to accept "Laurentian" as a term apparently stratigraphic and co-ordinate with stratigraphic terms, though the formation is separated from the Keewatin (and Huronian?) by eruptive rather than unconformable contact—a kind of contact that I take not to have stratigraphic meaning.

If I had believed that this committee or any committee could make a final and binding determination of names, I should not have signed it, for I think the scheme will probably not prove to be final; but I did sign it as being the best practical working arrangement, with our present knowledge. Words are but labels for concepts, and our concepts must vary more or less as our knowledge increases, while it is desirable that our labels should remain as fixed as possible. I hope that the decision of the committee will prove to be the best that could have been done at present toward naming the rock formations so that future modifications will still apply the same names to most of the rocks involved. In the first place, I may frankly say that I have yet to see any rocks in the Laurentian, as defined by the committee, that I should class as a softened underlying formation. The granite and gneisses, etc., are crystallized from aqueo-igneous fusion, and have been at a temperature (under conditions) considerably beyond the consolidation point, as it seems to me,<sup>2</sup> as their grain shows.

<sup>1</sup> *Journal of Geology*, Vol. XIII, pp. 89-104.

<sup>2</sup> *American Geologist*, February, 1905.

At the same time, one who accepts Chamberlin's planetesimal theory must, I suppose, believe that all molten rocks have come from fusion earlier or later. But that would apply to all igneous rocks, and I do not see why it should involve a separate stratigraphic treatment of any, and these Laurentian granites, instead of being an immediately older formation, might be eras older. We find, however, able geologists, represented on the committee, who hold the subcrustal fusion theory probable or possible, and we find this theory implied in previous use of some of the Lake Superior stratigraphic terms; and I frankly own that I know of no conclusive arguments against it. Any agreement we may make as to the use of "Laurentian" is likely to be more or less of a compromise, and the problem is so to define terms that their application should be as far as possible the same, their extent represented by closely overlapping circles, whatever each man may privately think about the true inwardness of the connection of the rocks thus grouped.

The two terms the application of which we really had to delimit were Logan's terms "Huronian" and "Laurentian," and we have arrived at a temporary *modus vivendi* by using Lawson's "Keewatin" (Irving's "greenstone schists," Van Hise's "Mareniscan," Wadsworth's "Cascade," Rominger's "Dioritic group") as a buffer state.

One cannot fairly deny that Logan's idea of the Laurentian was a purely stratigraphic one, since it was divided into an upper and lower division, and that our proposed use of the term restricts it to part of the lower part of the same only. But the fact is that Logan founded the Laurentian and its divisions in eastern Canada. Then he came to Lake Huron, and for very good reasons erected another system, the Huronian, which in its most typical part is, we all agreed, younger than his Laurentian. So far we were led to the conventional arrangement of Archean, divided into Huronian and Laurentian, which one finds in most of the geological textbooks.<sup>1</sup> But, unfortunately (as it seems to me), Logan included in his original Huronian area a series of rocks, there relatively insignificant, green chloritic schists (3 c of Logan), which the committee report calls the Thessalon series. This series is, as we have said, intruded by granites, and it seems to me that the rocks are stratigraphically as low and temporally

<sup>1</sup> Dana, Giekie, Lapparent, Credner, Kemp's *Ore Deposits*, etc.

as old as any rock series that we now know. So here we have a clear case of overlap between the definitions of "Huronian" and "Laurentian." Moreover, we do not really know how far up in the Huronian the overlap extends, and this fact weighed much in my mind in favoring the final compromise. The Hastings series of the upper Laurentian is largely a limestone-dolomite series. So is the Mesnard series (or lower Huronian of the report) from the Gogebic Range through the original Huronian area north of Lake Huron, and it seems to me possible that the Mesnard series may prove to connect with the original upper Laurentian. If this should be so, it should of course be taken into account in drawing the line between Huronian and Laurentian.

Another factor complicates the situation, I am informed. Just as in going west from New York, through Ohio to Michigan, the only part of the original New York Lower Helderberg remaining was the Waterlime, the rest being absent by unconformity, and so the typical Lower Western Helderberg of Orton and Rominger corresponds to a member that some of the New York geologists are now inclined to prune off from the Helderberg entirely; so it has been with the Huronian. The chloritic schist type, so comparatively insignificant in the original Huronian area, if we have made no mistake, covers great regions and becomes very important elsewhere, and is essentially the formation Lawson called Keewatin, but has often been mapped as Huronian, while granite and light-colored gneisses have been mapped as Laurentian, without knowing or caring (so far as the mapping was concerned) whether they cut the green chloritic schists or not. To call these chloritic schists Laurentian would be to upset the nomenclature very extensively.

Moreover, we do not really *know* that the upper Laurentian may not be a formation older and beneath these chloritic schists, though I have not the slightest suspicion that it is. Thus it seemed well to retain for these chloritic green schists, so different in many ways from the Huronian, a name of their own, and among those used for them Lawson's seemed to have clear priority among geographical names. I must confess I am enough of a heretic to yearn personally for the good old descriptive terms like "greenstone schists."

"Laurentian" is thus left out in the cold as an accurately defined

stratigraphic term. It is a residual term under which all large old (or ill-known) batholiths or plutonic rocks may be grouped, and I presume will prove very convenient in this elastic sense. I shall use it about as Brooks used it. Those who believe in sub-crustal fusion will, however, use it, applying it to very much the same rocks, but implying more, that they are softened parts of the basement of the Huronian. It is hardly likely that the term will stay in this stage of definition very long. As the original Laurentian area is more carefully studied and its connections with Lake Superior made out, I presume we shall find out just about what proportion of the original Huronian must be taken from the bottom to be equivalent to the original Laurentian, and we should then revert to the original division of the Archean into the Huronian above and Laurentian beneath.

A few words, in conclusion, as to the top of the pre-Cambrian. Here, as usual throughout the geological column, there is difficulty in fixing the exact line of division. That the main part of the Lake Superior sandstone is Cambrian I have no question. It is, in fact, upper Cambrian apparently. A specimen with trilobites from the Menominee Range, Mr. C. D. Walcott determined as of the *Ptychaspis* zone. Wells at Grand Marais and Lake Linden show that at those points it has over a thousand feet of thickness.

Dr. Hubbard has proved conclusively to me that it overlaps unconformably on the base of the Keweenawan.<sup>1</sup> But does that imply that the Keweenawan belongs to a different system? Neither Seaman nor I think so. For while there is the unconformity with the base of the Keweenawan, and the Keweenawan is very thick, this thickness of thousands of feet is composed of rocks which accumulate with extreme rapidity. They are almost wholly sandstones, conglomerates, and traps. Geologically, the Keweenawan may represent no more time than some of our present volcanoes lasting from Tertiary times. Moreover, in such a series intra-formational, and even more intra-systemic discordances may be expected. As a matter of fact, we find boulders and even agates of the Lower Keweenawan traps in the Upper Keweenawan. Yet there is a steady approximation, (1) in dips, (2) in stratigraphic distribution, (3) in disturbances,

<sup>1</sup> Vol. VI, Part II, pp. 110 ff.

(4) in lithological character, from the base of the Keweenawan to its upper portion, in the direction of likeness to the Lake Superior sandstone. (5) The deposition of this immense series must have been an era of subsidences, and the Lake Superior sandstone seems to have been formed through an area of subsidence; and outside certain limited areas like that near the Keweenawan fault there appears to have been no reversal of this subsidence between the Lake Superior sandstone and the Keweenawan, for the Lake Superior sandstone has but very little material that may be fairly supposed to have come from erosion of the Keweenawan. Its lithological character may be best explained as that of a bed mantling over the Keweenawan and deriving its material (frequently microcline) from the Laurentian granite bosses. But if the subsidence was not extensively broken and the Keweenawan is not Cambrian, then where are the middle and lower Cambrian?

The lithological character of the beds is such that fossils will hardly be found to help us. Of course, if Winchell proves to be right in saying that the Animikie is Cambrian, all the more would the Keweenawan be. But the Animikie is the kind of formation in which Cambrian fossils should be found, if present. I have never found them. The distribution of the Animikie and Keweenawan is quite discordant, and I think the Keweenawan much more closely associated with the Lake Superior or Potsdam sandstone.

Still, the argument above is not a coercive one. The true correlation of the Keweenawan is still an open question. And as the U. S. Geological Survey has consistently classed the Keweenawan as pre-Cambrian, I should not expect those at present in charge to change until convinced beyond question that in changing they were right. On the other hand, as my predecessors have classed the Keweenawan as Cambrian, and I believe them right, I cannot change. The only thing to do is to use the term "Keweenawan" or "copper-bearing," which is unambiguous, and avoid committing oneself, except in those formal classifications, where a formation must be placed in one pigeon-hole or the other, and then only with due reserve.